TENTH ANNUAL REPORT

OF THE

OHIO AGRICULTURAL

EXPERIMENT STATION,

FOR 1891.

PRINTED BY ORDER OF THE STATE LEGISLATURE.

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ORGANIZATION

OF THE

OHIO AGRICULTURAL EXPERIMENT STATION.

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HON JOSEPH H. BRIGHAM,	Delta.
R. H. WARDER,	North Bend.
THE GOVERNOR OF THE STATE,	*Ex-Officio*
THE DIRECTOR OF THE STATION,	*Ex-Officio*

OFFICERS OF THE BOARD.

SETH H. ELLIS,	President.
PROF. WILLIAM R. LAZENBY,	Secretary.
BERTHA E. WILDMAN,	Treasurer.

STATION STAFF

CHARLES E. THORNE,	Director.
WILLIAM J. GREEN,	Horticulturist and Vice-Director.
J. FREMONT HICKMAN, M. A. S.,	Agriculturist.
FRANCIS M. WEBSTER,*	Consulting Entomologist.
BERTHA E. WILDMAN,	Bursar.
FREDA DETMERS, M. Sc.,	Botanist.
EDWIN C. GREEN,	Foreman of the Gardens.
W. H. BAKER,	Meteorologist.

* Prof. Webster is special agent of the U S Department of Agriculture, Division of Entomology, and is located at this Station.

Tenth Annual Report.

REPORT OF THE BOARD OF CONTROL.

To Hon William McKinley, Jr., *Governor of Ohio:*

Sir: The Board of Control of the Ohio Agricultural Experiment Station submits herewith the annual reports of the Director and other officers for the year ending December 31, 1891.

The past year has been an eventful one in the history of the Station. In the last annual report were given reasons for believing that the time had come for considering the subject of the ultimate removal of the Station to a more eligible location.

At the request of the Board of Control the General Assembly passed an act providing for such removal, and authorizing the several counties of the State to raise money to secure the location of the Station.

The full text of the act is as follows:

AN ACT

TO AUTHORIZE THE SEVERAL COUNTIES OF THE STATE TO RAISE MONEY TO SECURE THE LOCATION OF THE OHIO AGRICULTURAL EXPERIMENT STATION AND TO PROVIDE FOR SUCH LOCATION.

Section 1. *Be it enacted by the General Assembly of the State of Ohio,* That the commissioners of any county in this state desiring to secure the location of the Ohio agricultural experiment station by making donations therefor, are hereby authorized and empowered to raise money for such donation by tax on all taxable property in such county, as listed on the county duplicate for taxation, the amount of which proposed donation shall be fixed by said commissioners.

Sec. 2. That such tax shall not exceed one mill on the dollar of the taxable property of the county in any one year, nor shall the aggregate of all levies for such purposes exceed ten (10) mills on the dollar.

Sec. 3. No such tax shall be levied or donation made until the question as to the amount to be donated has first been submitted by the county commissioners to the qualified voters of such county at some special election, a notice of which (specifying the amount to be donated) has been given at least thirty days previous to said election, in one or more newspapers published and in general circulation in the county; which election shall be held at the usual places of holding elections, and conducted in all respects, as far as may be, as other elections, except that the returns shall be made to the county commissioners, at the auditor's office; and those

voting at such election in favor of said tax, shall have written or printed on their ballots the words, "Experiment Station Tax—Yes," and those voting against the same, the words, "Experiment Station Tax—No." And said commissioners shall meet at said auditor's office on the fourth day next after the said election, and canvass the votes; and if it appear that said tax is approved by a majority of the qualified electors voting at such election, then it is hereby made the duty of the county commissioners of said county to levy a special tax on all the taxable property of said county, to raise the sum donated by said vote, in accordance with section two of this act; and the money arising therefrom, when collected, shall be applied to no other purpose but the payment of bonds and interest as hereinafter provided for; and said special tax shall be entered upon the county duplicate, and be collected in like manner as other taxes are collected.

SEC. 4. That to anticipate the collection of the tax authorized by this act, and the use of the money to be raised thereby, the county commissioners, on acceptance of the donation herein contemplated, are hereby authorized and required to issue and negotiate the bonds of such county, in sums of not less than five hundred dollars each, payable (within ten years) at such times, and bearing interest at a rate not exceeding six per cent., payable semi-annually, as the commissioners shall determine, which bonds shall not be sold or donated at less than their par value; and the proceeds thereof shall, on their receipt, be paid by said commissioners to the treasurer of state to the amount of said donation.

SEC. 5. Such funds as may be paid into the state treasury under this act shall be held subject to the duly authenticated requisitions of the board of control of said station, such requisitions to be accompanied with vouchers showing the purposes for which the requisitions are drawn.

SEC. 6. The board of control of said agricultural experiment station shall accept such donation as may in their judgment be most advantageous to the station, and it shall then be their duty to select within the borders of the county, the donation of which is accepted, suitable lands for the use of said station, said lands to be as convenient of access from all parts of said county as may be practicable, and also to be accessible by railroad from all parts of the state. Provided, that any member of the board of control who shall accept or receive, directly or indirectly, any money or property on condition of using his influence in favor of locating said experiment station at any particular place, shall be held to be guilty of a misdemeanor, and on conviction thereof in any court of competent jurisdiction, shall be fined not less than one thousand nor more than ten thousand dollars.

SEC. 7. The board of control shall have power to receive and hold in trust for the use and benefit of the experiment station any grant or devise of land, and any donation or bequest of money or personal property to be applied to the general or special use of the station, as may be directed by the donor.

SEC. 8. The title for all lands for the use of said experiment station shall be made in fee simple to the state of Ohio, with covenants of seizin and warranty, and no title shall be taken to the state for purposes aforesaid until the attorney-general shall be satisfied that the same is free from all defects and incumbrances.

SEC. 9. The attorney-general of the state shall be the legal adviser of said board of control, and he shall institute and prosecute all suits in behalf of the same, and shall receive the same compensation therefor as he is entitled to by law for suits brought in behalf of the asylums of the state.

SEC. 10. This act shall take effect and be in force from and after its passage.

Copies of this act, with a circular explaining some of the benefits to a county which might be expected to follow the location of the Station within its borders, were sent to the Boards of Commissioners of every

county in the State. Within a few weeks offers were received from the Commissioners of Wayne, Clark and Warren counties, proposing to donate $85,000, $75,000 and $40,000, respectively, subject to the approval of the people.

After a careful survey of Wayne and Clark counties, it was decided that the available sites in Wayne county offered a better opportunity for the prosecution and development of the work of the Station than those in Clark. Therefore, the proposal of that county was accepted on the first of September.

The Commissioners immediately issued the required notice of election, and on the sixth of October the election was held. It resulted in a vote of 4,045 in favor of the measure and 1,069 against. The bonds thus authorized were sold on the 16th of December, and the proceeds have been paid into the State Treasury. Since that date the Board of Control has purchased for the Station a tract of land consisting of 452 acres, situated one mile south of the principal street of the city of Wooster. In expending the donation of Wayne county, the Board of Control has conscientiously endeavored to so locate the Station as best to serve the interests of the farmers of that county, as well as those of the State at large.

Upon examination of a map of Wayne county showing its public roads, it will be observed that although the city of Wooster is not located in the geographical center, yet the public roads radiate from it in such a manner as to make it more easily accessible to the county at large than any other locality. Although there is as yet but one railroad in operation through Wooster, it is one of the great trunk lines of the State, intersecting no less than twenty-five other railways. It will thus be seen that no serious difficulty need be experienced in reaching the Station from any part of the State.

The proper equipment of the Station farm will involve a considerable expenditure for buildings, fencing, draining, livestock, implements, etc. A part of this expenditure will be met by the unexpended balance of the Wayne county donation, but this surplus will not be sufficient for the entire equipment. The Station is now being established on a permanent foundation, and a wise economy demands that its buildings should be of a substantial character.

No less than eight American experiment stations have suffered the loss of some of their principal buildings by fire during the past three years. The offices, libraries and museums of an experiment station often contain collections which it is absolutely impossible to duplicate, and such collections are constantly increasing in size and value. It is the desire of the Board of Control to so construct the principal buildings of the new Station that they can not be destroyed by fire.

The principal office building will be erected and paid for out of Wayne county's donation, but for other improvements and needed equipment we ask the General Assembly to make the following appropriations:

Main barn for feeding experiments, with fire-proof basement	$16,000
Green-houses and insectary	6,500
Boiler-house, heating apparatus, water and gas supply	4,500
Fencing and drainage	4,000
Stock for fruit and forestry planting	1,000
Livestock	7,000
Tool-house	1,500
Two dwellings	6,000

We also ask for an appropriation of $500 to continue the field experiments with insects and fungous diseases of plants, full information concerning which will be given in the report of the Horticulturist, and one of $350 for expenses of the Board of Control.

As the Station is a State institution, and one a very large proportion of whose work is of such a character that it must be of as much value to any other county in the State as to the one in which it is located, the Board of Control feel that it is a matter of simple justice that the State at large should furnish the necessary buildings and stock for the equipment of the farm.

The work that the Ohio Station has done the past season justifies a generous support. We call especial attention to the continued study and examination of the soils of the State with reference to the best methods of maintaining fertility, and to the experiments and tests with fungicides and insecticides which have given such valuable results.

The State appropriations of last year, amounting to three thousand four hundred dollars, have been or are being expended for the purposes for which they were granted, viz.: Eight hundred dollars for a fire-proof safe, office furniture and museum cases; six hundred dollars for field experiments with insects and fungous diseases of plants; one thousand dollars for sub-stations for field experiments with fertilizers; three hundred dollars for repairs and improvements; two hundred dollars for expenses of Board of Control, and five hundred dollars for illustrating bulletins.

During the year the following changes have been made in the Board of Control and working staff of the Station: J. L. McIlvaine, whose term of office as a member of the Board expired, was succeeded by the appointment of R. H. Warder. C. M. Weed, Entomologist and Botanist, resigned April 1, to accept a position in the New Hampshire Agricultural College. Dr. H. J. Detmers, Veterinarian and Bacteriologist, severed his connection with the Station July 1, in order to give his entire time to the professorship of Veterinary Science in the Ohio State University. John A. Alwood, foreman of the farm, resigned April 1. Prof. F. M. Webster,

special agent of the Division of Entomology, United States Department of Agriculture, was appointed Consulting Entomologist to this Station June 1. With the above exceptions the officers of the Station remain the same as last year.

The ability and enthusiam shown by all the officers in carrying on the work of the Station is fully appreciated by the Board of Control, and special attention is called to the reports of the Director and other members of the Station staff, which give a comprehensive summary of the work of the year.

Respectfully submitted.

WILLIAM R. LAZENBY,
Secretary Board of Control.

REPORT OF THE TREASURER.

HON. S. H. ELLIS, *President Board of Control:*

SIR: I have the honor to submit herewith the financial report of the Station for the fiscal year ending June 30, 1891:

Statement A is a statement of account with the appropriation received from the U. S. Treasury, as provided for by the Hatch act, and is a copy of the report made to the Governor of the State and the Secretary of the U. S. Treasury.

Statement B shows the receipts from the produce of the farm and garden and the expenditures from this fund.

STATEMENT A.

THE OHIO AGRICULTURAL EXPERIMENT STATION IN ACCOUNT WITH THE UNITED STATES TREASURY.

Dr.

1891.		
To receipts from Treasurer of the United States, as per appropriation for year ending June 30, 1891, under act of Congress approved March 3, 1887		$15,000 00

Cr.

June 30, by	salaries	$8,081 25	
"	labor	3,817 16	
"	supplies	860 83	
"	freight and expressage	43 89	
"	tools and implements	239 22	
"	furniture and general fittings	26 20	
"	technical apparatus and supplies	145 58	
"	library	71 85	
"	printing, postage and stationery	1,436 84	
"	travel	127 92	
"	incidentals	12 35	
"	buildings	136 91	
Total			$15,000 00

We, the undersigned, duly appointed auditors for the corporation, do hereby certify that we have examined the books and accounts of the Ohio Agricultural Experiment Station for the fiscal year ending June 30, 1891; that we have found the same well kept and correctly classified as above, and that the receipts for the time named are shown to have been $15,000.00, and the corresponding disbursements $15,000.00, for all of which proper vouchers are on file, and have been by us examined and found correct.

S. H. ELLIS,
R. H. WARDER,
Auditors Board of Control.

I hereby certify that the foregoing statement of account, to which this is attached ed, is a true copy from the books of account of the institution named.

BERTHA E. WILDMAN,
Treasurer Board of Control.

STATEMENT B.

OHIO AGRICULTURAL EXPERIMENT STATION IN ACCOUNT WITH PRODUCE FUND.

TO RECEIPTS.

Dr.

1891.			
June 30, from sales of milk		$3,021 84	
" "	agricultural produce	1,323 42	
" "	horticultural produce	1,473 10	
" labor		168 89	
Total			$5,987 25
Cash on hand July 1, 1890			513 19
Total			$6,500 44

BY EXPENDITURES.

Cr.

1891.			
June 30, for labor		$4,150 55	
" supplies		551 56	
" freight and expressage		145 35	
" tools and implements		6 45	
" livestock		747 93	
" furniture and general fittings		48 45	
" technical apparatus and supplies		62 28	
" library		60 68	
" printing, postage and stationery		48 85	
" travel		5 60	
" incidentals		77 98	
" buildings (material and labor)		474 55	
Total expenditures			$6,380 23
By balance, carried forward			120 21
Total			$6,500 44

In addition to the income shown by the above statements, the sum of $3,200.00 was received from the State Treasury by an appropriation made by the Legislature in the winter of 1890. Following is a statement of account with this appropriation, at the close of the fiscal year, ending June 30, 1891:

STATEMENT C.

STATEMENT OF ACCOUNT OF OHIO AGRICULTURAL EXPERIMENT STATION WITH STATE TREASURY.

Date.	Appropriation for—	Receipts.	Expenditures.	Balance.
1891.				
June 30	Finishing and furnishing museum and library	$600 00	$423 29	$176 71
	Equipment of chemical laboratory	1,000 00	1,000 00	
	Repairs and addition to barn, and dynamo or engine	1,200 00	1,200 00	
	Laboratory of Entomologist and Botanist	200 00	200 00	
	Expenses of Board of Control	200 00	104 15	95 85
	Totals	$3,200 00	$2,927 44	$272 56

The three foregoing statements are combined in Statement D, which shows the total receipts and expenditures for the year.

STATEMENT D.

TOTAL RECEIPTS AND EXPENDITURES OF THE OHIO AGRICULTURAL EXPERIMENT STATION FOR THE FISCAL YEAR ENDING JUNE 30, 1891.

RECEIPTS.

From U. S. Treasury	$15 000 00	
" sales of produce and labor	6 500 00	
" State Treasury	3,200 00	
Total		$24,700 44

EXPENDITURES.

For salaries	$8,081 25	
" labor	7,957 71	
" supplies	1,454 57	
" freight and expressage	189 24	
" tools and implements	815 53	
" livestock	747 93	
" furniture and general fittings	74 65	
" technical apparatus and supplies	1,220 55	
" library	137 53	
" printing, postage and stationery	1,485 69	
" travel	133 52	
" incidentals	90 33	
" buildings	1,805 02	
" expenses of Board of Control	104 15	
Total		$24,307 67
By balance		392 77
Total		$24,700 44

PERMANENT IMPROVEMENTS.

From the expenditures of the three different funds as itemized in the above statements, the amount used in permanent improvements on the farm is shown in Statement E:

STATEMENT E.

Buildings, material and skilled labor	$1,513 67	
" ordinary labor	291 35	
Total		$1,805 02

The expenditures from the appropriation of $3,400 received from the State Legislature in the winter of 1891, having practically come within the fiscal year 1891–92, a statement of the same will be included in the next annual report of the Station.

Respectfully,

BERTHA E. WILDMAN,
Treasurer.

REPORT OF THE DIRECTOR.

HON. S. H. ELLIS, *President Board of Control:*

SIR: I herewith respectfully submit the tenth annual report of the Ohio Agricultural Experiment Station for the year 1891:

THE SEASON.

A large portion of Ohio was visited by destructive frosts on the nights of the 7th and 17th of May, which killed large fruits almost completely in a broad belt through the northern half of the State and greatly reduced the crop of strawberries. The young growth of grapevines was generally killed, and even hickory trees had their foliage destroyed when in almost full leaf. During August and September the northern half of the State suffered severely from drouth. With these exceptions the season has been generally favorable to the farmer, and the cereal crops have given a full average yield.

THE STATION'S WORK.

The general work of the Station has followed the lines indicated in previous reports. A feeding experiment, carrying still further the investigation into the comparative feeding value of corn silage and field beets, which had been the subject of two previous feeding tests, was made in the winter of 1891; its results have been held for publication in connection with a third experiment which is now in progress. The field experiments in the control of insects and fungous diseases of plants, for which a special appropriation was made by the General Assembly, have been carried out as planned, and have yielded results of very great value. These results are given in detail in Bulletin No. 9; they have demonstrated the practicability of very greatly improving the quality of apples and pears by spraying with fungicides, and of reducing the injury from curculio and other insects by adding an insecticide to the fungicide. Were we to stop here the work would be abundantly justified; but there are a few points upon which we believe further investigation is required, and we therefore ask for an appropriation of $500 to be used in continuing these investigations another season. These points will be explained in the report of the Horticulturist, following.

CO-OPERATIVE EXPERIMENTS.

It gives me pleasure again to acknowledge the valuable assistance which farmers and fruit-growers in various parts of the State have rendered to the Station. The necessity for extending certain lines of the Station's investigations far beyond the limits of any single farm or county is self-evident, and the experiments made by intelligent farmers and fruit-growers, working in co-operation with the Station, have accomplished results which it would have been impossible to attain without their assistance.

But experimentation is expensive work, and it is not just to ask the private farmer to give his time and labor for the benefit of the public, nor is it possible for the Station, with its present resources, to compensate co-workers of this sort to the extent which the importance of the work demands.

I believe that the time is at hand for seriously considering the practicability of establishing sub-stations or test farms in various parts of the State, whereon such problems may be studied as are likely to be affected by variations of soil or climate. These sub-stations will not require for their equipment any of the expensive technical apparatus which constitutes a large portion of the outfit of the central Station, nor will it be necessary to man them with persons whose scientific training enables them to command high salaries. Their work should be planned and directed from the central Station, in order that it may be effectively co-ordinated, and in order that the duplication of laboratories and other technical outfit may be avoided; but in those lines of work which are of most immediate benefit to the farmer, provided they are conducted on a soil and under a climate similar to his own—such lines of work as the comparison of varieties of grains, fruits and vegetables and the study of the problem of maintaining the fertility of the soil—such a sub-station may accomplish more for the farmers of a given region than it is possible for any distant Station to do, however thoroughly it may do its work.

The farmers of Wayne county have manifested their faith in possibilities of agricultural experiment in a decisive manner. It is possible for the farmers of other counties to realize a considerable portion of the benefit to be derived from having such a Station in their midst at a comparatively insignificant cost, and I commend the enterprise and example of Wayne county's farmers to the farmers of other sections.

For the purposes of these sub-stations a farm of fifty to one hundred acres would be sufficient, and in many cases it would not be necessary to purchase any land, for in almost every county of the State there are already one or more public farms, a portion of many of which could be utilized for experimentation without any detriment to the public interest.

Such a sub-station might be managed by the local agricultural society, or the Board of County Commissioners, acting jointly with the Board of Control of the central Station.

PUBLICATIONS.

The publication of the newspaper bulletins of the Station has been continued throughout the year through the courtesy of the CENTRAL PRESS ASSOCIATION of Columbus, and these bulletins have received a wide circulation by republication in other journals.

The publication of the regular, or monthly bulletin, was practically suspended during the first half of the year, owing to the great amount of other printing required of the State printers during the session of the General Assembly and for some months thereafter. The annual report for 1890 was placed in the printer's hands in January, but was not printed until about the first of August, and bulletins prepared for publication during the winter were laid aside because they could not be issued in season to be of any service to farmers during the current year. It is to be hoped that some way may be devised by which more prompt publication may be secured hereafter.

Including the present number, ten bulletins have been issued during the year. A summary of the contents of these is here given, for the reason, explained in previous reports, that this is the only publication of the Station that is included in the report of the State Board of Agriculture.

BULLETIN No. 1, VOL. IV, JANUARY, 1891, BY J. F. HICKMAN AND C. E. THORNE.

ARTICLE I. *Experiments with corn—Continued,* including comparison of varieties, distribution of seed, seed from different parts of the ear, deep and shallow cultivation, methods of harvesting, varieties of ensilage corn, and use of fertilizers on corn. Following is a summary of the results attained:

Varieties: (*a.*) From the large yellow dent class only a few are recommended for Ohio soil, namely: Big Buckeye, Leaming, Leaming Improved, Murdock's Yellow Dent and Woodworth's Yellow Dent. From among these the Leaming or Leaming Improved might be selected as the most prolific.

(*b.*) Briar Crest Beauty, Chester County Mammoth, Golden Beauty, Golden Dent and Cloud's Early Dent are large and productive varieties, but can not be relied upon to mature on Ohio soils.

(*c*) Golden Dent and Golden Beauty are believed to be one and the same variety. The Leaming and Leaming Improved do not show any marked variation in point of productiveness, and it is questionable whether the one has any advantage over the other.

(*d.*) The Clarage from among the medium dents and the Butcher corn from the mixed dents are both good varieties, and will mature in an ordinary season.

(*e.*) The Farmers' Favorite is a good yielder, but has failed to mature this season. This we think was entirely due to the short and unfavorable season.

(*f.*) From the list of white dents should be excluded Blount's White Prolific and Old Cabin Home, on account of their failure to mature. They require a longer season than our latitude affords.

2. *Distribution of seed:* (*a.*) The results of previous experiments are confirmed by the work of this year in showing that more and better corn can be raised to the acre where the stalks average twelve inches apart than where they are at less or greater distances.

(*b.*) The results in general are as good where the corn is planted in hills as when planted in drills, when the average distances of the grains or stalks are the same.

3. *Seed from different parts of the ear.*—The results of four years' comparative test fail to show any marked superiority in the productiveness of seed taken from the butt, middle or tip of the ear.

4. *Deep and shallow cultivation.*—The results of two years' experiments are slightly in favor of shallow culture.

5. *Methods of harvesting.*—The exact stage of maturity at which corn is cut may materially affect its final yield per acre.

6. *Varieties of ensilage corn.*—Red Cob Ensilage, Blount's White Prolific and B. & W. are good varieties for the silo. Early Sanford and sweet fodder corn are not as a rule profitable in this State for silo purposes.

Corn intended for the silo should be planted previous to the middle of May to insure a sufficient degree of maturity.

7. *Fertilizers on corn.*—The results of two years' experiment, conducted on the Station farm and in various sections of the State, indicate that the use of commercial fertilizers on corn, at present prices of grain and fertilizers respectively, is likely to result in loss more often than in profit.

BULLETIN No. 2, VOL IV, FEBRUARY, 1891, BY C. M. WEED.

ARTICLE II. *Miscellaneous experiments in the control of injurious insects.*—London purple was found much more liable to injure foliage than Paris green, but this injury was almost entirely prevented by the addition of lime to the spraying liquid. In large plum orchards, spraying with London purple was found a practicable preventive of the curculio. In one experiment, spraying with a lime whitewash protected grapes from the rose bug. Several remedies for the cucumber beetle are given, and experiments are reported showing the effectiveness of tobacco dust as an insecticide.

ARTICLE III. *Some common cabbage insects.*—An illustrated description, with preventives, of several of the more common cabbage depredators.

ARTICLE IV. *Three important clover insects.*—An illustrated description of the clover root borer, the clover seed midge and the clover hay-worm.

BULLETIN No. 3, VOL. IV, AUGUST 1, 1891, BY C. E. THORNE AND J. F. HICKMAN.

ARTICLE V. *Commercial and other fertilizers on wheat,* with an appendix describing some fertilizing materials and their use. Following is the summary of results of field trials with fertilizers for two years:

In 1890 the various fertilizers used produced, in every case, some increase of crop. When nitrate of soda was used alone its cost was recovered in the increase of crop, counting wheat at $1.00 per bushel, but in no other case, in the Station test, was the cost of any of the fertilizers or combinations of fertilizers recovered, except in that of barnyard manure.

In the test in Columbiana county the increase of crop on plot 2 apparently justified the use of superphosphate; but this increase was not confirmed by the duplicate plots 5 and 8, hence we are led to doubt whether this increase may not have been due to natural superiority in the soil of this plot. In general the fertilizers added less to the unaided yield of the Columbiana county soil than they did to that of the Station soil, notwithstanding the fact that the unfertilized plots on the Station farm yielded twice as much wheat on an average as did those on the farm in Columbiana county.

In the tests of 1891 at the Station, the fertilizers have in every case, caused a decrease of crop where superphosphate was used. Nitrate of soda, alone or with potash, has produced a slight increase, but in no case has the increase been sufficient to justify the use of the fertilizer, and this applies both to the wheat grown continuously on the same soil and to that grown in rotation.

In the tests of 1891, the wheat grown in rotation, without fertilizers, has yielded as large an average crop as the best obtained from the use of the fertilizers in 1890, although the yield from the unfertilized plots under continuous cropping was practically the same in both seasons

BULLETIN No 4, VOL. IV, AUGUST 25, 1891, BY J. F. HICKMAN.

ARTICLE VI. *Experiments in wheat seeding*, including treatment of seed for smut.

Quantity of Seed per Acre.

Summary: (1.) This experiment, which has been continued for a series of ten years, furnishes conclusive evidence that higher yields are obtained from seeding at a rate not below five pecks per acre, nor exceeding seven pecks.

(2.) Seeding below four pecks per acre gives a fewer number of bushels of inferior quality.

Seeding above seven pecks per acre gives fewer bushels, but a superior quality of grain.

Methods of Seeding and Winter Protection.

(1.) Broadcast seeding has given as good results this year as drilling, but in a series of years drilling has produced the largest crop.

(2.) Very light mulching has apparently been of some benefit this year. Heavier mulching has invariably injured the crop.

(3.) Cross drilling has shown no advantage this year.

(4.) No larger crop has been produced this year from mixed seed of two varieties than from pure seed of the same varieties, sown separately.

(5.) The "stinking smut," or "bunt" of wheat may be almost completely eradicated by soaking the seed wheat in solution of copper sulphate, and the same result may be more economically obtained by immersing the seed in water heated to 132° to 135° Fah.

ARTICLE VII. *Comparative test of varieties of wheat*, sixty-five differently named sorts being grown on plots of one-tenth acre each:

Summary: (1.) The red bearded varieties producing the highest yields for the year were Rudy, Valley, Diehl-Mediterranean and Lehigh in the order named. The white bearded varieties giving the highest yields were Democrat, Golden Prolific and Silver Chaff.

(2.) Of the smooth red wheats Red Fultz, Poole and Witter stand at the top of the list, while the Surprise and Miller's Prolific are among the highest producing white smooth varieties.

(3.) The Farquhar, Geneva, New Monarch, McQuay, Hungarian and Ontario Wonder are apparently more susceptible to smut than other varieties in the list.

(4) Among the newer varieties the Mealy and Rudy are the most promising, while the Hybrid Larned and the Hybrid Dattle are thus far decided failures.

(5.) The variations in weight per measured bushel in the several varieties between the screened and unscreened grain has run from nothing in some varieties up to thirteen per cent. in others.

(6.) The proportion of straw to grain was greater this year on land where wheat had been grown for ten years than it was on land where a system of rotation has been followed.

(7.) *Diseases and Insects.* Rust was seemingly as bad upon one variety as another.

The Scab attacked later varieties more than earlier ones.

The "Bunt" or Stinking Smut was worse upon some varieties than others.

The wheat midge or "red weevil" appeared in spots rather than upon particular varieties.

BULLETIN No. 5, VOL. IV, SEPTEMBER 1, 1891, BY F. M. WEBSTER.

ARTICLE VIII. *The Wheat Midge.*—A description of this insect (often called the red weevil) with a history of its appearance, spread and depredations in Ohio. Concerning remedies, Mr. Webster says:

The present season (1891) the wheat midge appeared in the wheat fields of the Experiment Station in considerable numbers. From glancing over the preceding record of the occurrences of the pest during past years, it will be clearly observed that local outbreaks like this, lasting but a single year, are of common occurrence, and it is not possible to say now, to what extent the insect will appear next year, or even if it will appear at all. Therefore, while late varieties and late sown grain would probably be most affected, in case of a reappearance, the early sown grain will court the attack of Hessian fly. Hence, the prospect of the reappearance of the midge next year, does not seem to me sufficient to warrant advising generally early sowing this fall, as a means of protecting the crop next season.

BULLETIN No. 6, VOL. IV, OCTOBER, 1891, BY W. J. GREEN AND FREDA DETMERS.

ARTICLE IX. *Experiments With Small Fruits in* 1891.

Summary: (1.) The blossoms of perfect flowered varieties of strawberries are more easily killed by frost than those having imperfect flowers.

(2) Haverland, Crescent, Warfield and Bubach are the most reliable of the fully tested varieties of strawberries. Gandy, Pearl and Miner are suitable for pollenizers.

(3.) The new varieties of strawberries that are the most promising are Brunette, Barton's Eclipse, Beder Wood, Dayton, Enhance, Greenville, Ivanhoe, Lovett's Early, Muskingum, Parker Earle and Shuster's Gem.

(4.) The following require further trial, but so far seem to be worthy: Bessie, Edgar Queen and Van Deman.

(5) The following appear to have but little value or at least some serious faults: Stevens, Great Pacific, Lady Rusk.

(6.) The following well known and fully tested varieties of raspberries are recommended for general cultivation: Gregg, Ohio, Hilborn, Palmer, Turner, Cuthbert, Brandywine and Shaffer.

(7.) The following new varieties of raspberries are promising: Cromwell, Kansas, Lovett, Muskingum, Royal Church, Thompson's Early Prolific.

(8.) Smith's Prolific appears to be of little value because of its tendency to rust.

(9.) The hardiest varieties of blackberries, and most suitable for this latitude, are Snyder, Ancient Briton and Agawam.

(10.) Erie and Minnewaski are the most promising of the newer varieties.

(11.) The value of Early Harvest seems to have been overlooked. It is very early and comparatively hardy.

(12.) Wilson Jr. and Child's "Everbearing Tree Blackberry" are too tender for this latitude. The latter name is a misnomer, and the variety is the most nearly worthless of any that has been tested here.

(13.) The following mixture has proved efficient in preventing the raspberry scab, or anthracnose: Copper sulphate, 4 pounds; lime, 4 pounds; water, 50 gallons.

(14.) Four applications should be made during the season, the first before growth has commenced in the spring and the last just before the time of blooming.

(15.) Care should be taken in making the second, third and fourth sprayings, to direct the spray towards the young canes, and to keep it off the leaves of the bearing canes.

(16.) Six ounces of copper carbonate dissolved in three pints of ammonia, and diluted with water to fifty gallons is nearly as efficient as the above, but preference is given to the dilute Bordeaux mixture.

ARTICLE X. *Diseases of the Raspberry and Blackberry.*—A technical description of anthracnose, *Septoria rubi*, red rust and a bacterial "blight" of the raspberry and blackberry.

BULLETIN No. 7, VOL. IV, NOVEMBER, 1891, BY F. M. WEBSTER.

ARTICLE XI. *The Hessian Fly.*—Description and historical notes concerning this insect, with account of experiments for its control.

Summary: The Hessian fly is a small, two-winged fly about one-eighth of an inch long and of a dusky color and appears during May and June and again in September and October. The eggs are deposited on the upper side of the leaves, and the young, as soon as they hatch, make their way down the plant, behind the sheath, to near the lower joints and there become imbedded in the soft part of the stem. Here they pass the winter and also the summer, in the former case in young wheat, and in the latter case in the stubble. The adults appear and the eggs are deposited at dates varying with the latitude, being earlier in the fall to the northward and later to the southward.

The preventives are, burning stubble, late sowing, rotation of crops. Pasturing early sown wheat in the fall may destroy many of the maggots and "flaxseeds."

BULLETIN No. 8, VOL. IV, NOVEMBER, 1891, BY C. E. THORNE.

ARTICLE XII. *Forty Years of Wheat Culture in Ohio.*—A statistical study of the forty wheat harvests, 1850 to 1889, inclusive, from which the following conclusions are drawn:

It would seem that the average yield of wheat is increasing in the northern and central sections of the State, while it is at a standstill, and standing at far too low a point for profit, in the southern and south-eastern counties.

It would seem that the profitable culture of wheat on the steep hillsides of southern Ohio is a hopeless undertaking; that the great problem before the wheat grower of the central belt of counties is winter-killing, a problem which may be partially solved by underdrainage and the intelligent use of clover and manures; and that in the northern counties climatic influences are more generally favorable to wheat culture than elsewhere in the State.

These statistics indicate that the wheat crops of Ohio have been slightly increased by the use of commercial fertilizers, but it appears that the average cost of this increase has equaled its market value and that a general improvement in the methods of agriculture has contributed more largely to the increase of Ohio's wheat crops than the use of purchased fertility.

It would seem that the total area under wheat might be considerably enlarged, and at the same time more closely restricted to lands adapted to tillage, and that the yield per acre may be so increased that the total product shall reach double the quantity now annually produced.

BULLETIN No. 9, VOL. IV, DECEMBER, 1891, BY W. J. GREEN AND FREDA DETMERS.

ARTICLE XIII. *The Apple Scab.*—A technical description, illustrated.

ARTICLE XIV. *The Spraying of Orchards*, including: (1) Spraying to prevent the scab of the apple and pear; (2) spraying for the plum curculio; (3) spraying for the "shot-hole" fungus of the plum; (4) preparation of spraying mixtures; (5) manufacturers and dealers in spraying appliances.

Summary: (1) The apple scab is a parasitic fungus, growing upon leaf and fruit, and flourishing in cool, moist weather.

(2) The effect of the scab is to cause a large proportion of the fruit to drop while quite small; to greatly disfigure and reduce the size and market value of that which matures, and to injure the vitality of the tree by causing a premature falling of the foliage

(3.) The growth of the scab fungus may be checked by spraying the trees at proper times during the spring with several of the copper compounds commonly used as fungicides.

(4.) The most satisfactory compound thus far tested, regard being had to cost, convenience and effectiveness, is a "dilute Bordeaux mixture," containing four pounds copper sulphate, four pounds lime and fifty gallons of water.

(5.) While it was not found practicable to completely prevent the growth of the scab in a single season, the experiments demonstrate that it is practicable to so reduce the injury from the fungus that the total value of the crop shall be very greatly increased, and that the value of this increase will far more than repay the necessary cost of using the fungicide.

(6) The effect of judicious spraying with fungicides is to check the dropping of immature fruit in the spring; to cause it to grow to larger size and more free from blemishes; to cause it to hang better to the tree while ripening; to cause it to take on higher color in ripening, and to improve its keeping quality. As measured by market value, spraying has added nearly 100 per cent. to the value of the crop at a cost of less than fifteen cents per tree.

(7.) It has been demonstrated that the plum curculio may be held in check by spraying almost or quite as effectually as by jarring, and far more cheaply.

FARMERS' INSTITUTES.

The members of the Station staff have taken an active part in the farmers' institutes held throughout the State during the winter. For the opportunity of meeting the farmers of the State in these institutes we are again indebted to the cordial co-operation of Mr. L. N Bonham, Secretary of the State Board of Agriculture, under whose direction the institutes are conducted.

ACKNOWLEDGMENTS.

The publishers of the following journals have aided the Station in its work during the year, either by republishing abstracts from its bulletins or by donating their publications to its library:

AGRICULTURAL PAPERS OF OHIO.

American Farm News, Akron.
American Grange Bulletin, Cincinnati.
Buckeye Farmer, New Carlisle.
Co-operative Farmer, Columbus.
Farm and Fireside, Springfield.
Farmers' Alliance Herald, Cardington.
Farmers' Home, Dayton.
Gleanings in Bee Culture, Medina.
Ohio Farmer, Cleveland.
Our Rural Home, Cleveland.
Stuart's Agriculturist, Cleveland.

GENERAL PAPERS OF OHIO.

Arcanum Enterprise, Arcanum, Darke county.
Attica Journal, Attica.
Auglaize County Democrat, Wapakoneta.
Bakersville Press, Bakersville.
Barnesville Republican, Barnesville.
Bethel Review, Bethel.
Cincinnati Weekly Commercial Gazette.
Cincinnati Weekly Enquirer.
Cortland Herald, Cortland.
Daily Democrat, Springfield.
De Graff Buckeye, De Graff.
Democratic Herald, Delaware.
Democratic Record, Chardon.
Economist, The, Cincinnati.
Fredericktown Free Press, Fredericktown.
Fremont Journal, Fremont.
Greenville Democrat, Greenville.
Industrial News, Toledo.
Jacksonian, Wooster.
Leader, Chillicothe.
Lewisburg Reporter, Lewisburg.
Lodi Review, Lodi.
Malta Register, Malta.
Northern Ohio Journal, Painesville.
Ohio State Journal, Columbus.
Painesville Telegram, Painesville.
Pataskala Standard, Pataskala.
Plain City Dealer, Plain City.
Press, The Daily, Columbus.
Public Opinion, Westerville.
Republic Times, Springfield.

Sandusky Democrat, Sandusky.
Scio Weekly Herald, Scio.
Shelby News, Shelby.
Springfield Daily Gazette, Springfield.
Tuscarawas Advocate, New Philadelphia.
Tuscarawas Chronicle, Uhrichsville and Dennison.
Union County Journal, Marysville.
Valley Enterprise, Milford.
Wayne County Democrat, Wooster.
Wayne County Herald, Wooster.
West Liberty Banner, West Liberty.
Wooster Daily Republican, Wooster.

MISCELLANEOUS PAPERS.

AGRICULTURAL.

Agricultural Epitomist, Indianapolis, Ind.
Agricultural Journal, Montgomery, Ala.
Agricultural Science, Lafayette, Ind.
Agricultural Science, New South Wales.
Alliance Farmer and Rural Messenger, Petersburg, Va.
American Agriculturist, New York, N. Y.
American Bee Journal, Chicago, Ill.
American Farm Horticulturist, Richmond, Va.
American Garden, New York, N. Y.
American Homestead, Omaha, Nebr.
American Rural Home, Rochester, N. Y.
Breeder's Gazette, Chicago, Ill.
Canadian Entomologist, London, Ont.
Country Gentleman, Albany, N. Y.
Dakota Farmer, Huron, S. Dakota.
Farm and Home, Chicago, Ill.
Farmers' Advocate, London and Winnepeg.
Farmers' Institute, Mason City, Ia.
Farmers' Voice, Chicago, Ill.
Farm, Field and Stockman, Chicago, Ill.
Farm Implement News, Chicago, Ill.
Farm Journal, Philadelphia, Pa.
Farm, Stock and Home, Minneapolis, Minn.
Florida Agriculturist, De Land, Fla.
Holstein Friesian Register, Boston, Mass.
Home and Farm, Louisville, Ky.
Horticultural Art Journal, Rochester, N. Y.
Husbandman, The, Elmira, N. Y.
Indiana Farmer, Indianapolis, Ind.
Journal of Agriculture, St. Louis, Mo.
Journal of Mycology, Washington, D. C.
Maritime Agriculturist, St. John, N. B.
Mark Lane Express, London, Eng.
Meehan's Monthly, Germantown, Philadelphia, Pa.
Mirror and Farmer, Manchester, N. H.
National Horticulturist, Cambridge, Md.
National Stockman and Farmer, Pittsburg, Pa.
New Dairy, The, New York, N. Y.

Orange Judd Farmer, Chicago, Ill.
Orchard and Garden, Little Silver, N. J.
Our Country Home, New York, N. Y.
Pacific Rural Press, San Francisco, Cal.
Practical Farmer, Philadelphia, Pa.
Prairie Farmer, Chicago, Ill.
Rural Critic, Garrettsville, Otsego Co., N. Y.
Rural New Yorker, New York, N. Y.
Science, New York, N. Y.
Southern Cultivator and Dixie Farmer, Atlanta, Ga.
Sugar Beet, Philadelphia, Pa.
Weekly Globe and Canada Farmer, Toronto, Canada.
Western Breeder, St. Joseph, Mo.
Western Garden and Poultry Journal, Des Moines, Ia.
Western Resources, Lincoln, Nebr.
Western Stockman and Cultivator, Omaha, Nebr.
Western Swineherd, Geneseo, Ill.
Wisconsin Farmer, Madison, Wis.

GENERAL.

Albilene Reporter, Albilene, Tex.
Baltimore Sun, Weekly, Baltimore, Md.
Boston Globe, Weekly, Boston, Mass.
Detroit Free Press, Detroit, Mich.
Engineering and Mining World, The, New York, N. Y.
Hospodar, Omaha, Nebr.
Industrial American, Lexington, Ky.
National Provisioner, New York, N. Y.
Press, The Weekly, New York, N. Y.
Press, The Weekly, Philadelphia, Pa.
Republican Leader, New Lisbon, O.
World, The Weekly, New York, N. Y.

IMPLEMENTS, SEEDS AND PLANTS RECEIVED.

Thanks are returned for the following donations to the Station:

AGRICULTURAL DEPARTMENT.

The Cleveland Linseed Oil Co., 5 sacks linseed meal.
D. K. Brewer, Xenia, O., seed wheat.
Chas. W. Bush, Selden, O., seed wheat.
W. H. Denlinger, Eaton, O., seed wheat.
The Emerson Seed Co., Omaha, Neb., 4 varieties seed corn.
Steel Bros., Toronto, Ontario, seed wheat and carrot seed.
The Kentucky Experiment Station, Lexington, Ky., seed wheat.
The Missouri Experiment Station, Columbia, Mo., seed wheat.

HORTICULTURAL DEPARTMENT.

E. W. Cruse, Leavenworth, Kansas, 3 varieties strawberry plants.
H. S. Crow, Little York, O., 1 variety strawberry plants.
Samuel Dagwell, Utica, N. Y., 1 variety gooseberry plants.
J. T. Derror, Pavonia, O., 1 variety raspberry plants.

Frank Ford, Ravenna, O., currant and blackberry plants.
Mr. Hilborn, Leamington, Ont., 1 variety currant.
Jacob Knopp, Columbiana, O., 1 variety raspberry plants.
R. D. Luther, Fredonia, N. Y., 1 variety blackberry.
L. Madison, Chili, O., 1 variety raspberry.
E A. Ruhl, Alton, Ill., 1 variety strawberry plants.
Wm. A. Maule, Philadelphia, Pa., potatoes and seeds.
M. T. Thompson, Rio Vista, Va , 1 variety strawberry.
J. C. Vaughan, Chicago, Ill., seeds.
U. S. Dept. of Agriculture, Washington, D. C., seeds and scions.
Milliken Bros., Traverse City, Mich., Acme Potato Planter.
A. W. Livingston's Sons, Columbus, O., seeds
George S. Josselyn, Fredonia, N. Y., 1 variety gooseberry plants.
The Perfection Sprayer Co., Waterloo, Ind., hand spraying machine.

The Acme potato planter is a small machine, designed to be used in a similar manner to the common hand corn planters. It was received too late to give it a thorough test, but from its construction we would expect it to be useful in planting small lots of potatoes.

The spraying machine is a syringe, designed for spraying single plants, such as rose bushes, etc.

The seeds and plants will be reported upon in future bulletins.

In conclusion, I have the pleasure of reporting another year of earnest, harmonious effort on the part of those directly engaged in the Station's work, and of cordial and united effort on the part of the Board of Control.

CHAS. E. THORNE,
Director.

REPORT OF THE AGRICULTURIST.

The work of this department has been conducted along the same general lines as indicated in former reports; some features of the work being curtailed, while others have been extended by additional work to bring out special points of interest heretofore undeveloped.

Experiments with field crops continue to be the leading work of the department. During the year the following work has been carefully carried on:

Wheat (1.) A comparative test with sixty-five varieties, among which were six previously untried upon the Station grounds.

(2.) A comparative test of fourteen of these varieties upon first and second bottom land, and upon land on which a rotation had been followed, compared with yields from land upon which wheat had been grown continuously for ten seasons.

(3.) Seeding at different rates per acre, duplicating each plot, then reduplicating the first list with another variety.

(4.) Methods of seeding, such as drilling the land both ways, putting on one-half of the seed at each drilling; seeding the land with two varieties of wheat thoroughly mixed; deep and shallow planting; rolling before and after seeding; shoe drilling and hoe drilling conpared; broadcasting compared with drilling; mulching compared with unprotected wheat land

(5) Practical tests for destroying smut germs on seed wheat; (*a*) by treating with copper sulphate solution; (*b*) by treating with hot water.

(6.) Experiments with commercial and other manures, both on Station and other grounds.

Oats. Experiments with oats for 1891 were conducted on exactly the same lines as are given in previous reports, including variety tests; thick and thin seeding, and tests with commercial and other manures.

The almost total failure of the oats in 1890 left us such an inferior grade of seed from our small plots that the growth of this year from the seed of last was very irregular, and as a consequence the study of synonyms was in a measure out of the question, though some progress has been made.

The results of experiments with oats for 1890 and 1891 will be ready for publication at an early date.

Corn. (1.) (*a*) About twenty-six varieties of dent corn were planted for a comparative test in yields of grain per acre (*b*) Seven varieties of ensilage corn for a comparative test of fodder yields per acre. (*c*) Four of the best producing varieties were sent into twelve different counties of the state to responsible farmers, for a comparative test upon different soils

(2.) Experiments in methods of planting and culture were conducted as follows: (*a*) Contrasting deep and shallow culture (*b*) Distribution of seed, including hill and drill planting. (*c*) Testing vitality of seed by planting continuously seed from the same parts of the ear. (*d*) Experiments with commercial and other manures were conducted both upon the Station and other grounds, including in all thirty-eight tenth-acre plots.

In addition to the above series of plots in wheat, oats and corn a block consisting of thirty-five one-twentieth acre plots has been devoted to a system of rotation, in the order of corn, oats and wheat, followed by two years in grass.

Fourteen plots were devoted to German millet, and to testing the utility of oil-meal as a fertilizer; the results were compared with yields from the use of nitrate of soda.

Field beets. Nearly four acres of land were devoted to mangels and sugar beets, including the following:

(*a.*) Comparative test of varieties.

(*b.*) Continuation of test on soil exhaustion.

(*c.*) The effect of transplanting on mangels with and without topping.

(*d.*) Growing sugar beets isolated and dense for the purpose of comparing quality.

(*e*) During the year the test of 1890 was repeated to show the actual cost of producing an acre each of mangels and ensilage corn.

In all the variety tests the aim is to reduce the number each year by discarding worthless varieties and giving more attention to the more promising ones, and using them as standards to compare with the new varieties that are constantly appearing and demanding attention.

Dairy. The repairing done to the dairy barn in 1890 enabled us to enlarge upon the feeding experiment for 1891, which was conducted upon substantially the same basis as the feeding trial of 1890, namely: a comparison of ensilage and mangels in the production of milk.

During the entire year the milk from each of thirty cows has been carefully weighed and a record kept; an analysis of each cow's milk has been made some three or four times by Babcock's method, while the milk

of each cow in the feeding experiment has been tested each week during the experiment.

It is but simple justice to say here that my department has been disturbed upon every side by the city improvements, which have made inroads in almost every field experiment. The intercepting sewers have destroyed entirely a part of the wheat, oats and corn work. The grading of Neil avenue through the north field destroyed one plot of oats in the fertilizer tests and reduced the size of the millet plots Truant boys burned a part of a plot of corn, and some bicycle riders threw a locked gate off its hinges and let the whole herd of cows into a field of corn.

The intercepting sewer work has caused extra expense to the department, because we were compelled either to keep our cattle in the barn yard about one-half the time during the summer or else have a herdsman with them. These annoyances have not made any of our reported work any the less accurate, but they have in every case caused some work to be thrown out because of its being unreliable. The constant danger from trespassers has required no little patience and considerable extra work both to myself and farm hands during the six or seven months of open weather. Aside from this the work in my department has moved on harmoniously and satisfactorily.

J. FREMONT HICKMAN,
Agriculturist.

REPORT OF THE HORTICULTURIST.

The work in the Horticultural Department the past season has been along the same lines as in former years, and in addition experiments with insecticides and fungicides have been conducted.

VARIETY TESTING.

The principal part of the work in variety testing was as follows:

(1.) Small fruits, including strawberries, raspberries and blackberries. An account of the varieties of the fruits named was given in the Bulletin for October, 1891. Other fruits were so much injured by frost that a report was not possible.

(2.) Vegetables. The work of testing varieties of vegetables and determining synonyms presents such difficulties that it was determined to make a new departure in methods. A variety test that is not carried through several seasons and on a considerable scale can not be conclusive, nor can synonyms be clearly made out unless observations are extended through several seasons. Hence it was determined to report upon no class of vegetables until the work was carried as far as means would permit, and as the results seemed to warrant and necessity demanded. It becomes necessary in carrying out this plan to make a separate report upon novelties as often as may be necessary. Such a report will probably be made during the year. The most important variety work now in progress is with onions, celery, lettuce, radishes, cauliflower, tomatoes, sweet corn and peas.

With onions the varieties are tested both in the ordinary manner, by sowing the seed in the open ground, and by sowing in the greenhouse and transplanting This increases the work and makes a careful study of synonyms necessary. Considerable attention was given to this vegetable the past season, but the results are not ready for publication.

Lettuce and radishes are tested in the greenhouse, in hot beds and in the open ground. The progress made last season with these vegetables was satisfactory, but some results need verification.

Variety work with peas has been confined mainly to a comparison of the different strains of the so-called extra earlies.

The work with celery and sweet corn can probably be reported upon the coming season.

A variety test of potatoes was made at the Station and small lots were also sent to growers in different parts of the State, and the results will be given in a subsequent bulletin.

Tomato trials have been made in the greenhouse and out of doors.

GREENHOUSE WORK.

Two well constructed greenhouses, each 20 by 100 feet, have been in use two seasons. Lettuce, radishes and tomatoes are the leading crops grown and mainly for variety testing, but not wholly. The houses have also been used for starting all classes of plants that are to be transplanted into the open ground. Asparagus, dandelion, pie plant and mushrooms have been grown under the benches

Fertilizer tests were made last winter upon lettuce, radishes and tomatoes, the particular point aimed at being to test the value of nitrogenous fertilizers upon the above named crops when grown under glass. The results were wholly negative, no evidence being secured that would indicate that nitrate of soda or sulphate of ammonia were of any benefit. A rich compost was of course used, such as is ordinarily employed by gardeners.

Underground or sub-irrigation has been experimented upon two seasons in the greenhouse, the primary object being to supply water to lettuce plants without wetting the leaves, in order to test the theory that wet foliage favors the development of the rot fungus. These experiments are not complete, but the evidence is favorable to the plan. Not only is there less rot upon the sub-irrigated plots, but the growth is much better than upon those where surface watering alone is practiced, the increase in yield of crop being from 20 to 40 per cent. The indications at present are that this method of watering promises much for lettuce growers, but more experiments are needed to settle some points.

The greenhouses are heated with hot water, one being piped overhead, and the other underneath the benches. The difference between the results obtained with the two systems is not sufficient to warrant many general statements. The snow melts more quickly on the house where overhead heating is practiced, and the plants in this house are rather taller than in the other, but so far as lettuce is concerned the average weight per plant is about the same in the two houses. At present it would seem to be largely a matter of convenience as to which method should be adopted. The size of the glass is 16x24, and the evidence is decidedly in favor of this rather than a smaller size.

CULTURAL METHODS.

Sub-irrigation has been given some attention, and particularly in connection with the bed method of growing celery. The experiments are not far enough advanced to speak confidently, but there seems to be reason to believe that the method can be used successfully upon this and several other garden crops.

A report can be given the coming season on the bed method of growing celery, and some other improvements in details of growing this crop.

Experiments in transplanting onions have been continued, and some new facts brought out that are of value, a report of which must be deferred for a time.

SPRAYING TO PREVENT FUNGOUS DISEASES AND THE DEPREDATIONS OF INSECTS.

A report of this work has been given in Bulletin No. 9, December, 1891. There still remain some important questions to be investigated. Of the mixtures advised by other experimenters, the dilute Bordeaux mixture seems to possess the greatest advantages, but a new compound, devised last season and not fully tested, seems to be superior for certain purposes, and deserves further testing. The time that fungicides should be applied, as well as the number of applications, needs further investigation. Results indicate that early applications are necessary, but more complete demonstration is needed, nor have we yet determined the minimum number of sprayings required. Some indications sustain the belief that there might be a reduction of the strength of mixtures with economy and without risk. The plum rot and black knot are much dreaded diseases that have not been sufficiently experimented upon, but it is probable that both may be held in check with the proper preventives. Several diseases attack garden crops that have not been controlled. This work has been so full of good results the past season, and there are so many reasons for its continuance that it can not be dropped without great loss to important interests.

W. J. GREEN,
Horticulturist.

REPORT OF THE CONSULTING ENTOMOLOGIST.

By an arrangement between the Board of Control of the Station and the Entomologist of the United States Department of Agriculture, I was transferred to the Station on July 1st, 1891, the duties of Consulting Entomologist being added to those of Special Agent of the Division of Entomology, United States Department of Agriculture. It is expected that by this arrangement both the Department and the Experiment Station will be mutually benefited. The object of the combined offices will be the investigation of the habits of insects with especial reference to their relation to the various branches of agriculture, and to this object every thing else will be made subservient. Investigations and personal inspection will be made throughout the State when necessary, by order of the Secretary of Agriculture, and under the direction of the Entomologist, and the expense thereof will be borne by the Department. It is, therefore, especially desirable that all insect depredations be promptly reported to the Station. Bulletins will be issued from time to time, giving a concensus of all available information upon certain destructive insects, and the best methods of preventing or of controlling them.

In the matter of publications, the Consulting Entomologist has no personal pride whatever to gratify, and the number and nature of future bulletins will be largely in conformity with the actual wants of the agricultural public. The nature of correspondence received will be one of the important factors in deciding this matter. It is expected that each bulletin will treat of one or more insects separately, thoroughly, practically, and in as popular a manner as possible. As an illustration, Bulletin 5 treats of the Wheat Midge, Bulletin 7 treats of the Hessian Fly. Future numbers will be devoted to the consideration of other wheat destroying species, and the complete series will include all insects known to affect this cereal in the State of Ohio.

The limited time that has elapsed since the beginning of my work in this State will preclude the necessity for a lengthy report. The various subjects under investigation are as follows:

1. The Hessian Fly (*Cecidomyia destructor*), and the effect of climatic conditions on its development.

2. Studies of the various species of Crane Flies (*Tipulidæ*), with especial reference to preventing their depredations

3. Studies of the habits of the several species of White Grubs (*Lachnosterna*).

4. Studies of the Fruit Bark Beetle (*Scolytus rugulosus*).

5. Investigation of the habits of a timber boring beetle (*Lyctus striatus*).

In addition to these, work is being pushed forward relating to many other insects of the orchard, garden and field.

F. M. WEBSTER,
Consulting Entomologist.

REPORT OF THE BOTANIST.

Until April 1st, 1891, the division of Botany was united with the division of Entomology, and was under the charge of Mr. Clarence M. Weed. I was then his assistant. On the resignation of Mr. Weed, I was made Acting Botanist, and later, the Botanist of the Station. I did not assume charge of the work however until May 11th.

The work of the division during the past year has mainly been confined to a careful study of the fungous diseases of plants, and in one case of insects, especial attention being paid to those of economic importance. Briefly stated the diseases investigated are as follows: The diseases of the raspberry and blackberry, including the discovery of the occurrence of an undescribed bacterial disease affecting the Marlborough raspberry and the Snyder blackberry; apple scab; plum pockets; lettuce mildew; *Empusa Aphidis;* an undescribed bacterial disease of oats; a bacterial disease of turnips; an apparently new disease of fall wheat; and a septoria on *Lactuca scariola*, which to my knowledge has not been reported on that host.

The results of some these investigations have been published, the remainder are not yet ready for publication.

A descriptive catalogue of the Rusts of Ohio is also begun, and will be continued until the list is complete. Numerous letters of inquiry have been answered. Additions have been made to the herbarium from time to time. The specimens are being mounted, labeled and arranged this winter, preliminary to making out a catalogue of them.

Considerable time has been devoted to making drawings, charts, etc., for the other departments; and some time has been taken up with library work.

Respectfully submitted.

FREDA DETMERS,
Botanist.

REPORT OF THE METEOROLOGIST.

The weather of the year has been marked by the absence of extremes of temperature; high average temperature during December; nearly normal rainfall; late frosts, both in spring and fall; and an unusual amount of clear weather, especially during September, October and December.

Severe frosts occurring as late as the middle of May, seriously damaged the fruit crop. On the other hand the lateness of the first autumn frosts allowed the corn crop to ripen and all late crops to be well secured.

Cold, cloudy weather and frequent rains prevented any spring working of the ground until the last week of April.

Through the growing season the weather was mostly favorable. Harvest weather was fair. Corn suffered slightly from lack of rain in August and September, but ripened well in the bright weather. Fall pastures were short on account of the drouth during August, September and the first half of October.

The danger of a deficiency in the water supply for winter was removed by abundant rain in November.

EXPLANATION OF TABLES.

The following tables contain statistics of temperature, rainfall, etc., for the year, and are compiled from data obtained by daily observations, made at 7 A. M., 2 P. M. and 9 P. M. T stands for "trace," less than 0.01 inch of daily rainfall. Temperature is given in degrees, Fahrenheit.

Table I shows the daily rainfall at the Station during the year in inches and hundredths.

Table II shows the daily mean temperature for 1891, and the normal mean temperature for each day, computed from nine years' record.

Table III gives a comparison of the monthly mean temperature, humidity and rainfall for the Station and the State, with the nine-year averages for the same.

Table IV contains the record of atmospheric pressure; the mean temperature; the highest and lowest temperature, with the range of temperature for each month; the number of clear, fair, cloudy and rainy days; the rainfall and prevailing direction of wind for both the Experiment Station and State.

Table V shows the rainfall at the Station for each month during the last eight years.

Table VI contains the principal points of interest on the temperature, state of weather, and rainfall during the same period, and a grand summary for eight years.

I am indebted to the Ohio State Meteorological Bureau for the daily normal temperatures in table II, and for the statistics on the weather of the State.

METEOROLOGY.—TABLE I.—DAILY RAINFALL AT THE OHIO EXPERIMENT STATION FOR 1891.

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.40	.18		T	.03	.21						
2	.09		.40	.24	T	27		T				
3	T	.07	.30	.07	.09	.17	.61	.08				
4		.01		.21		.23	T		.19	.24		.37
5	T								.32	.01		
6	T		T	.05		.07			T			.22
7		.22	03			1.24	1.92		T	T		
8			.18				.05		T		.01	
9	.10	.62	.11	.27							T	
10	.21					.27					.85	
11	.69		T	.08	.02	.06		.13			T	
12	.30		.05					.27			.09	
13	T		.17						T			
14				.33			.62	T		.06		.01
15		.71		T					.37		.13	.31
16		1.93						.20			.73	
17		.01				.51		.04			.27	T
18				.02			33	.01		.72		
19		.10	.56		.03	.02			.03	1.62		
20		.46	.55		.45	.25		.02		.08		
21	.11	.25	.33	.40	.64	.25		.12		.03	.38	
22	.20		.02	.11	.54			T		.04	1.38	.10
23	T			.24	.70		.08	.89			1.70	.57
24		.13						.03				.48
25		.37										.01
26		.05	.38						.03		.04	.05
27			.33				.03	T			.02	
28	.17	.15	.06		.29		.14				.14	
29	.16				.08	.28	.08		.22		T	.30
30			.35	T		T	.55	.05				
31	.70		.57									
Totals...	3.13	5.26	4 38	2.02	2.87	3 83	4.41	1 84	1.16	2 80	5,74	2.42
Av.daily rainfall..	.10	.19	.14	.07	.09	.13	.14	.06	.04	.09	.19	.08

METEOROLOGY—TABLE II.—Daily Mean Temperature for 1891.

[N. stands for Normal Mean Temperature for nine years.]

	January.		February.		March		April.		May.		June.		July.		August.		September.		October.		November.		December.	
	1891	N.	1891.	N.	1891	N	1891.	N.	1891.	N.	1891.	N.	1891	N.	1891	N.	1891	N.	1891.	N.	1891.	N.	1891	N.
1	51	33	41	27	13	29	48	44	57	47	65	63	68	73	72	75	64	62	62	60	40	47	34	31
2	23	24	42	32	22	31	44	44	62	56	72	64	71	73	71	74	65	67	70	58	34	46	45	30
3	22	24	23	31	30	30	37	42	50	58	68	66	66	73	67	71	66	67	70	56	30	43	53	34
4	23	28	12	32	16	26	30	43	51	60	63	67	67	73	70	71	60	67	68	55	38	43	41	34
5	29	29	29	29	17	26	32	42	44	58	61	67	66	73	72	70	62	67	50	55	40	45	42	34
6	24	27	38	29	28	31	32	42	42	58	59	68	68	74	72	69	62	67	51	54	38	44	48	34
7	22	24	37	33	33	31	36	44	50	57	58	68	65	75	74	69	61	68	47	53	47	46	30	35
8	26	27	35	32	34	30	39	43	60	60	63	69	60	72	77	71	57	66	48	53	58	47	34	36
9	31	25	42	29	29	33	44	46	63	62	72	70	64	71	80	73	57	67	48	53	63	51	38	35
10	35	24	26	32	38	34	58	49	68	63	72	68	68	71	86	71	61	65	50	54	56	46	39	37
11	36	25	32	32	47	39	46	51	50	60	74	66	71	72	74	71	63	65	46	54	51	45	35	36
12	28	26	36	30	37	36	48	51	52	61	68	69	74	74	73	72	69	67	47	55	38	41	35	33
13	26	28	36	31	27	35	54	51	55	60	69	70	76	72	68	70	66	65	48	55	38	39	58	35
14	27	26	30	33	16	36	60	55	59	58	79	72	75	73	69	70	60	63	53	51	37	37	53	36
15	28	28	41	33	30	35	57	53	62	59	78	74	68	72	69	70	62	66	43	47	46	38	56	31
16	27	28	57	35	33	35	57	50	47	56	79	74	68	74	67	71	71	66	41	47	53	39	35	31
17	25	24	59	36	36	36	66	54	46	60	74	76	73	75	73	72	72	62	51	54	20	39	25	30
18	27	22	30	32	46	41	64	53	58	64	78	74	68	72	76	71	74	64	50	51	22	37	24	29
19	30	26	32	32	38	38	66	55	63	62	74	73	67	70	76	71	74	64	41	52	31	36	27	26
20	39	28	51	28	37	33	62	56	64	61	69	71	70	70	78	72	72	61	46	45	46	38	31	30
21	40	19	38	27	42	32	66	56	69	61	74	72	74	72	73	73	75	61	50	46	53	40	40	33
22	34	22	32	29	40	32	66	55	64	63	75	70	78	75	68	69	70	62	36	44	55	42	52	31
23	35	28	43	28	40	34	59	55	54	63	72	70	73	74	62	68	70	60	41	45	40	40	48	35
24	37	25	53	37	40	40	44	51	59	58	71	71	72	73	60	65	70	60	47	45	32	37	46	35
25	33	27	37	35	41	43	50	51	62	62	74	69	68	73	61	65	71	61	54	46	30	36	52	33
26	37	25	24	30	43	42	54	54	54	61	76	71	66	73	65	68	73	62	57	47	40	36	30	30
27	43	28	25	28	39	42	62	57	57	61	68	69	66	74	68	67	72	60	36	47	45	35	27	28
28	43	28	19	27	40	38	53	55	53	61	72	72	67	73	57	64	74	60	39	43	25	29	38	28
29	48	30	.....	.....	44	37	56	54	59	62	70	69	71	74	58	67	61	59	52	45	20	29	36	30
30	35	30	.....	.....	47	41	62	56	61	64	71	71	68	75	61	66	56	60	56	42	23	30	34	31
31	45	31	.....	.....	46	43	.....	.....	66	62	...	.....	67	76	64	64	.....	.....	56	44	.....	.....	44	36
Mean	32	26	36	31	35	35	52	50	57	61	71	70	69	73	70	70	66	64	50	50	40	40	39	32

METEOROLOGY.—TABLE III.—COMPARISON OF MEAN TEMPERATURE MEAN RELATIVE HUMIDITY AND RAINFALL FOR 1891.

	Jan.	Feb.	Mar.	Apr	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Mean temperature at the Station..	32°	36°	35°	52°	57°	71°	69°	70°	66°	50°	40°	39°	51°
Nine-year average temperature at the Station	26	31	35	50	61	70	73	70	64	50	40	32	50
Mean relative humidity at the Station	84%	79%	80%	75%	72%	78%	73%	82%	76%	75%	78%	75%	77%
Nine-year average humidity at the Station	88	86	81	75	77	79	76	78	78	80	82	83	81
Mean temperature for the State	33°	36°	35°	52°	58°	71°	69°	70°	67°	51°	40°	39°	52°
Nine-year average temperature for the State	27	31	35	50	60	69	73	70	64	51	41	33	50
Mean relative humidity for the State	85%	82%	82%	76%	73%	80%	76%	73%	77%	78%	77%	78%	78%
Nine-year average humidity for the State	83	82	79	73	74	77	74	75	77	79	79	81	78
	Inches.	*Inches.*	*Inches*	*Inches*	*Inches*	*Inches.*	*Inches.*	*Inches*	*Inches.*	*Inches*	*Inches.*	*Inches*	*Inches.*
Rainfall at the Station	3 13	5 26	4.28	2.02	2 87	3.83	4 41	1.81	1 16	2.80	5.74	2.42	39 86
Nine-year average at the Station	3.69	3.95	3.15	3.01	5 00	3 57	2.88	2 82	3.40	2.55	3 16	2 48	39.95
Mean rainfall for the State	2.82	4.91	4.19	2.13	2.20	4.82	3.82	3.07	1.50	1.76	5.00	2 39	38.61
Nine-year average for the State	3 31	3.94	2 93	2.70	4.04	3.97	3.42	3.34	3 10	2 65	3 26	2 54	39.52

METEOROLOGY.—TABLE IV.—Monthly Rainfall at the Experiment Station for Nine Years.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Total.
	Inches.	*Inches*	*Inches.*	*Inches.*	*Inches*	*Inches*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches*	*Inches.*
1883	2.90	5.81	2.87	2.98	5.76	4.70	2.92	2.12	3.13	4.34	3.87	4.97	46 37
1884	2.77	5.29	4.10	2.40	4.34	1.11	2.23	0.45	4.23	1.49	1.13	3 37	33.41
1885	4.03	3.17	0.98	4 51	5.92	4.84	3.01	5.50	2.00	3.12	2 89	1 68	41.65
1886	4.49	1.67	2.83	3.25	6.91	2.23	3 01	1.42	3.42	1.19	4.18	3 41	38 01
1887	1 54	6.85	2.84	4.45	4 36	5.47	1 56	2.47	1.82	0 38	2.64	2.04	36.62
1888	4.04	1.71	4.33	2.39	6.67	2.43	4.72	5.85	1.26	5.14	4 30	1 36	44.20
1889	3.90	0.81	1.00	1.11	3.46	2.08	2.85	2.07	3.77	1.79	3.72	2.24	28.80
1890	5.50	5.88	4.88	4.08	4.69	5.43	1.41	3.71	8 16	2.71	1.76	2 38	50.59
1891	3.13	5.26	4.38	2.02	2.87	3.83	4.41	1.84	1.16	2.80	5.74	2.42	39.86
Average	3.69	3.95	3.15	3.01	5.00	3.57	2.88	2.82	3.40	2.55	3.16	2.71	39.95

METEOROLOGY.—TABLE V.—SUMMARY BY MONTHS FOR 1891.

Month.	Barometer.						Mean relative humidity.			
	Mean.	Highest.	Date.	Lowest.	Date.	Range.		Mean.	Highest.	Date.
At the Experiment Station.										
January	30.09	30.69	8th.	29.31	1st	1.38	84	32	57	29th.
February	30 06	30 56	14th.	29.43	25th.	1.13	79	36	69	20th.
March	30 06	30 63	1st	29.55	21st	1.08	80	35	63	18th.
April	30 03	30 39	9th.	29 60	2d.	0.79	75	52	83	17th.
May	30.09	30.35	7th	29.82	2d.	0.53	72	57	88	10th.
June	29 94	30 16	5th.	29 56	18th.	0.60	78	71	91	26th.
July	30 02	30.27	10th.	29.79	18th.	0.48	73	69	89	22d.
August	30 01	30 24	25th.	29.71	1st.	0.53	82	70	94	*8.
September	30 15	30 46	10th.	29 94	3d.	0.52	76	66	93	*10.
October	30.12	30.53	28th.	29 70	4th.	0 83	75	50	86	*11.
November	30.12	30.70	18th.	29.23	23d.	1.47	78	40	70	9th.
December	30.16	30 66	12th.	29 58	4th.	1 08	75	39	61	15th.
Sums and averages	30 07	30.70	Nov. 18.	29 23	Nov. 23.	1.47	77	51	94	*14
For the State.										
January	30.09	30.74	8th	29.16	1st.	1.58	85	33	65	31st
February	30 07	30 62	14th.	29.32	25th.	1.30	82	36	80	20th.
March	30 08	30 69	1st	29.45	13th.	1.24	82	35	74	18th.
April	30.04	30.42	9th.	29 58	2d	0.84	76	52	95	17th.
May	30.10	30 39	7th.	29 76	2d.	0.63	73	58	93	10th.
June	29 96	30.27	5th.	29 65	19th.	0.62	80	71	98	*23.
July	30 03	30 35	10th.	29 72	18th.	0.63	76	69	95	22d.
August	29 99	30.25	25th.	29.60	20th.	0 65	73	70	101	10th.
September	30.14	30.46	10th.	29.83	3d.	0.58	77	67	99	19th.
October	30.14	30.58	28th.	29.65	4th.	0 93	78	51	93	2d.
November	30.12	30 79	18th.	28.89	23d.	1.90	77	40	76	9th.
December	30.16	30.72	18th.	29.43	4th.	1.29	78	39	66	3d.
Sums and averages	30.08	30 79	Nov. 18.	28.89	Nov. 23.	1 90	78	52	101	Aug. 10.

STATION—*1 March—7th, 20th, 22d and 27th. *2 April—13th, 17th, 26th and 27th. †3—2d and 4th. *8 August—9th and 10th. †9—7th and 8th. *10 September—20th and 21st. *11 October—2d and 3d.

STATE—*15 January—1st and 3d. †16—4th and 11th. *17 February—8th, 10th and 19th. *18 March 23d. *23 June—14th and 26th. *24 August—1st and 7th. *25 September—5th and 29th. *26 October 22d; November 12th; December 4th.

METEOROLOGY.—TABLE V.—SUMMARY BY MONTHS FOR 1891.

Temperature.								No. of days.						
Lowest.	Date.	Range.	Mean daily range.	Greatest daily range.	Date.	Least daily range.	Date.	Clear.	Fair.	Cloudy.	Rain fell.	Monthly rainfall.	Average daily rainfall.	Prevailing wind.
13	7th.	44	12	30	2d.	3	18th	4	9	18	11	3.13	.10	S. W.
6	4th.	63	18	36	20th.	5	8th.	9	7	12	15	5 26	.19	S.
—2	5th.	65	16	33	18th.	7	*1.	6	11	14	16	4.38	.14	N. E.
24	7th.	59	22	36	*2.	8	†3.	13	9	8	11	2 02	.07	N. W.
28	7th.	55	24	42	18th	6	23d.	14	12	5	10	2 82	.09	N.
52	*4.	39	22	35	†5	9	7th.	10	12	8	13	3.83	.13	S.
49	*6.	40	24	33	6th.	11	†7.	20	10	1	10	4.41	.14	S
43	29th.	51	24	33	†9.	11	23d.	9	18	4	11	1.84	.06	N. E.
38	9th.	55	30	39	21st.	6	4th.	20	7	3	6	1.16	.04	S.
21	28th.	65	26	43	17th.	8	9th.	17	8	6	8	2 80	.09	S.
12	30th	58	18	33	17th.	8	*12.	5	11	14	13	5.74	.19	S.
15	19th.	46	21	35	21st.	7	*13.	15	5	11	10	2 42	.08	S.
—2	March 5.	96	21	43	Oct. 17.	3	Jan. 18.	142	119	104	134	39.86	.11	S.
3	8th.	62	10	39	*15	2	†16.	3	8	20	11	2.82	.09	S. W.
—2	5th	82	18	44	20th.	3	*17.	5	9	14	12	4.91	.18	N. W.
—5	5th.	79	17	45	18th	2	*18.	7	6	18	14	4.19	.14	N. E.
15	*19.	80	22	50	†20th.	3	‡21.	12	9	9	8	2.13	.07	S. W.
25	17th.	63	24	48	14th.	4	*22.	12	10	9	8	2 20	.07	N.
40	5th.	58	22	45	14th.	3	16th.	15	15	14	13	4.82	.16	S. W.
41	27th.	54	24	43	6th.	6	8th.	16	10	5	7	3.82	.12	S. W.
39	29th.	62	22	41	*24.	3	23d.	13	11	7	10	3 07	.10	S. W.
36	9th.	63	25	45	21st.	4	*25.	20	7	3	6	1.50	.05	S. W.
20	28th	73	23	48	29th.	3	*26.	10	9	12	10	1.76	.06	S. W.
0	29th.	76	17	44	17th.	2	12th.	6	8	16	12	5.00	.17	S. W.
9	18th.	57	18	48	12th.	2	4th.	14	7	10	9	2.39	.08	S. W.
—5	March 5.	106	20	50	*27.	2	*28.	133	109	137	120	38.61	.11	S. W.

*4 June—5th 6th and 13th. †5—25th and 28th. *6 July—7th, 9th and 10th. †7—8th and 18th *12 November—22d and 29th. *13 December—15th and 24th. *14 Average—August 9th and 10th. —19th and 22d. *19 April—5th and 6th. †20—27th and 30th. ‡21—2d and 11th. *22 May—16th and —7th and 19th. *27 Average—April 27th and 30th. *28—January 4th and 11th; March 19th and

METEOROLOGY.—TABLE VI.—Summary by Years and Grand Summary for Nine Years.—*Part First.*

	1883.	1884.	1885.	1886.	1887.
At the Experiment Station.					
Mean relative humidity	82.3 per cent.	82.3 per cent.	84.2 per cent.	82.7 per cent.	79.2 per cent.
Mean temperature	49.1°	50 1°	47.4°	49.2°	50.8°.
Highest temperature	97 0° August 22.	97.0°, August 20..	101.0°, July 21	97 5°, June 4	102.5°, July 17.
Lowest temperature	—7. 0° January 12.	—32.0°, January 25	—20.0°, Feb. 21	—12 0°, Feb. 17.	—10.0°, Jan. 11.
Range of temperature	104 4°	129.0°	121.0°	109.5°	112.5°.
Mean daily range of temperature..	22.9°	24.8°	23.1°	23 6°	24.1°.
Greatest daily range of temperature	45 °, September 11	49.5°. July 22.	55.0°, Feb 2	48.0°, Feb. 17.	47.5° Sept. 5.
Least daily range of temperature	1.8°, January 28.	4.0°, Feb. 22.	4.0°, Dec. 10..	5.0°, Feb. 7.	3.0°, Dec. 12.
Number of clear days	105	103	83	107..	98.
Number of fair days	147	119	137	145	130.
Number of cloudy days	113	144	145	113	137.
Number of days rain fell	165	149	166	154	158.
Total rainfall..	46 37 inches.	33.41 inches.	41.65 inches.	38.01 inches	36.62 inches.
Mean daily rainfall..	0.127 inch.	0.091 inch.	0.114 inch..	0.104 inch.	0 100 inch.
Greatest monthly rainfall	5 81 inches, Feb	5.29 inches, Feb	5.92 inches May	6.91 inches, May.	6.85 inches, Feb.
Least monthly rainfall	2.12 inches, Aug	0.45 inch, Aug.	0 98 inch, March	1.19 inches, Oct.	0.38 inch, Oct.
Warmest day of year	82.7°, July 23.	80.5°, July 23.	85.8°, July 31	81.9°. July 29.	87.0°, July 17.
Coldest day of year..	1 0°, Jan. 22	—16.8°, Feb. 6.	—4.0°, Feb. 10..	—5.05°, Jan. 10	0.6°, Jan. 10.
Prevailing direction of wind	N. W.	S. W.	S. W.	S. W	S. W.
For the State.					
Mean relative humidity	76.3 per cent.	76 8 per cent.	77.5 per cent.	77 8 per cent.	75 8 per cent.
Mean temperature	49 4°	50.6°	48.0°	49.6°	51.4°.
Highest temperature	98.°, August 22.	99.0° Sept. 28 and Oct. 1	101.0°, July 21	98 6°, July 7.	103.0°, July 18.
Low st temperature	—17 2°, Jan. 22.	—34 0°, Jan. 25	—31.0°, Jan. 29.	—21.5°, Jan. 12.	—21 0°, Jan. 7.
Range of temperature..	115.5°	133 0°	132.0°	120.1°	129.0°.
Mean daily range of temperature..	19.8°	20.5°	20.4	20.2°	21.2°.
Greatest daily range of temperature	55.2°, March 18	50.0°, Sept. 5, and Dec. 4.	58 5°, Jan. 30	57.0°, Dec. 11	57.0°, April 11.
Least daily range of temperature	0.5°, December 23.	1.1° Feb. 6	1 0°. Apr. 18 and Dec. 31	1.1°, March 27.	1.6°, Jan. 15 and Apr. 16.
Average number of clear days	98 2	116.7	103.5	118.4	113.8.
Average number of fair days	135.4	118.3	132.8	125.7	127.3.
Average number of cloudy days..	130.4	131.1	128.2	121.0	123 9.
Average number of days rain fell	146 0	145 0	147.7	130.7	120.9.
Mean yearly rainfall	44.98 inches.	40 19 inches.	38.08 inches..	36.71 inches.	33 63 inches.
Mean daily rainfall	0.123 inch.	0.110 inch..	0.104 inch.	0.100 inch.	0.092 inch.
Prevailing direction of wind	S. W	S. W.	S. W.	S. W	S. W.

METEOROLOGY—TABLE VI.—*Part second.*

	1888.	1889.	1890.	1891.	Summary for nine years.
At the Experiment Station.					
Mean relative humidity	82.8 per cent.	79.8 per cent.	78.5 per cent.	77 per cent	81 per cent.
Mean temperature	49 6°	51 2°	52.8°	51°	50°.
Highest temperature	98 0°, June 20	93 0°, Aug 31 and Sept. 1	95.0° July 8 and 15	94°, Aug. 9 and 10	102.5°, July 17, 1887.
Lowest temperature	—11.0°, Jan. 28	1.0° Feb. 23.	4 0°, March 6	—2°, March 5	—32°, January 25, 1884.
Range of temperature	109.0°	92 0°	91.0°	96°	134 5°.
Mean daily range of Temp	21.1°	20,8°	19 1°	21°	22°.
Greatest daily range of Temp	43.2°, April 28	41.5°, April 23	41.0°, January 13	43° Oct. 17	55°, February 2 1885.
Least daily range of Temp	4.1°, Aug. 21	3.0°, Jan. 6 and Nov. 20	2.0°, December 17	3°, Jan. 18	1.8° January 28 1883.
Number of clear days	96	124	115	142	108.
Number of fair days	141	113	125	119	131.
Number of cloudy days	129	128	125	104	126.
Number of days rain fell	142	163	163	134	155.
Total rainfall	44.20 inches	28 80 inches	50 59 inches	39.86 inches	39 95 inches.
Mean daily rainfall	0 120 inches	0 079 inch	0 139 inch	0.11 inch	0.11 inch.
Greatest monthly rainfall	6.67 inch May	3 90 inches in January	8.16 inches in Sept	5.74 inches in Nov	8.16 in. in Sept. 1890.
Least monthly rainfall	1.26 inches, Sept	0 81 inch in February	1.41 inches in July	1.16 inches in Sept	0 38 inch in Oct. 1887.
Warmest day of year	84.1° June 20	80 5°, July 9	86 1°, July 30	86°, Aug. 10	87°, July 17, 1887.
Coldest day of year	7 5° Feb. 9	4 9°, February 23	12 8° March 6	12°, Feb. 4	—16.8°, Feb. 6, 1884.
Prevailing direction of wind	S. W	S. W	S	S	S. W.
For the State.					
Mean relative humidity	78.2 per cent.	79 4 per cent.	80.2 per cent.	78 per cent	78 per cent.
Mean temperature	49.5°	51.1°	52.4°	52°	50°.
Highest temperature	102 0°	99 5°, August 31	103.1°, August 3	101°, Aug. 10	108°, July 18, 1887.
Lowest temperature	—15.0°, Jan. 27	—13 5°, February 24	—4° March 7	—5°, March 5	—34°, Jan. 25, 1884.
Range of temperature	117.°	113 0°	107.1°	106°	142°.
Mean daily range of Temp	19.6°	19 3°	19°	20°	20°.
Greatest daily range of Temp	50 0°	53 0°, March 30	49 5°, April 11	50°, April 27 and 30	58 5°, Jan. 30, 1885.
Least daily range of Temp	1.2°, Jan. 16	1 0° January 5	1 0°, December 17	2°*	0.5°, Dec. 23, 1883.
Average number of clear days	108 7	112 8	103.4	133	112.
Average number of fair days	123.4	113 8	121.6	109	123.
Average number cloudy days	133.9	138.4	140 3	137	131.
Average number of days rain fell	124.7	114.8	149.4	120	133.
Mean yearly rainfall	39 64 inches	38.83 inches	50.33 inches	38.61 inches	39.52 inches.
Mean daily rainfall	0.108 inch	0.092 inch	0.138 inch	0 11 inch	0.11 inch.
Prevailing direccion of wind	S. W	S. W	S. W	S. W	S. W.

*January 4 and 11; March 19 and 22; November 12; and December 4.

NOTES ON THE WEATHER AT THE STATION.—SUMMARY BY MONTHS.

JANUARY.

The mean temperature was 32°, 4° above the Station average for January. The highest temperature, 57°, occurred on the 29th; the lowest, 13°, on the 7th.

The mean relative humidity was 84 per cent. Cloudy weather prevailed. Rain fell on nine days and snow on eight, on five of the latter, however, only a trace fell. The total snowfall for the month was 5.50 inches; the total rain and melted snow, 3.13 inches, which is .56 inch below the Station average for January. The greatest daily rainfall was .70 inch, on the 31st.

Fogs occurred on the 1st and 10th.

The prevailing wind was south-west.

FEBRUARY.

The mean temperature was 36°, 5° above the Station average for February. The highest temperature, 69°, occurred on the 20th; the lowest, 6°, on the 4th.

The mean relative humidity was 79 per cent. Cloudy weather prevailed. Rain fell on twelve days and snow on five. The total snowfall for the month was 2.20 inches; the total rain and melted snow, 5.26 inches, which is 1.31 inches above the Station average for February. The greatest rainfall in 24 hours was 2.60 inches on the 15th and 16th.

Thunder was heard in connection with rain on the 9th and 25th.

A lunar halo occurred on the 21st.

The prevailing wind was south.

MARCH.

The mean temperature was 35° which is the Station average for March. The highest temperature, 63°, occurred on the 18th; the lowest,—2°, on the 5th.

The mean relative humidity was 80 per cent. Cloudy weather prevailed. Rain fell on fourteen days and snow on four. The total snowfall was 8.50 inches; the total rain and melted snow 4.38 inches, which is 1.23 inches above the Station average for March. The greatest rainfall in 24 hours was .91 inch on the 30th and 31st.

A killing frost occurred as late as the 29th.

A solar halo occurred on the 18th; lunar halos on the 18th and 24th.

A fog occurred on the 8th.

The prevailing wind was north east.

APRIL.

The mean temperature was 52°, 2° above the Station average for April. The highest temperature, 83°, occurred on the 17th; the lowest, 24°, on the 7th.

The mean relative humidity was 75 per cent.

Clear weather prevailed. Rain fell on ten days and snow on one. The total snowfall for the month was .50 inch; the total rainfall, 2 02 inches, which is .99 inch below the Station average for April. The greatest daily rainfall was .40 inch on the 21st. Only a trace of rain fell after the 23d.

Thunder storms occurred on the 9th, 21st and 22d.

Killing frosts occurred on the 7th and 8th; light frosts on the 9th, 25th, 26th, and 29th.

Lunar halos occurred on the 17th and 18th.

The prevailing wind was north-west.

MAY.

The mean temperature was 57°, 4° below the Station average for May. The highest temperature, 83°, occurred on the 10th; the lowest, 28°, on the 7th.

The mean relative humidity was 72 per cent.

Clear weather prevailed Rain fell on ten days. The total rainfall for the month was 2 87 inches, 2.13 inches below the Station average for May. Nearly all of this fell during the latter half of the month. The greatest rainfall in 24 hours was 1.24 inches on the 22d and 23d.

Thunder storms occurred on the 21st and 22d.

Killing frosts occurred on the 5th, 7th, and 17th; light frosts on the 4th, 12th, and 18th.

The prevailing wind was north.

JUNE.

The mean temperature was 71°, 1° above the Station average for June. The highest temperature, 91°, occurred on the 26th; the lowest, 52°, on the 5th, 6th and 13th.

The mean relative humidity was 78 per cent.

Fair weather prevailed. Rain fell on thrirteen days. The total rainfall for the month was 3.83 inches, .26 inch above the Station average for June. The greatest rainfall in 24 hours was 1.27 inches on the 6th and 7th.

Thunder storms occurred on the 1st, 2d, 3d, 4th, 10th, and 29th.

A lunar halo occurred on the 15th.

The prevailing wind was south.

JULY.

The mean temperature was 69°, 4° below the Station average for July. The highest temperature, 89°, occurred on the 22d; the lowest, 49°, on the 7th, 9th, and 10th.

The mean relative humidity was 73 per cent.

Clear weather prevailed. Rain fell on ten days. The total rainfall for the month was 4.41 inches, 1.53 inches above the Station average for July. The greatest rainfall in 24 hours was 1.97 inches on the 7th and 8th.

Thunder storms occurred on the 3d, 7th and 14th.

The prevailing wind was south.

AUGUST.

The mean temperature was 70°, which is the Station average for August. The highest temperature, 94°, occurred on the 9th and 10th; the lowest, 43°, on the 29th.

The mean relative humidity was 82 per cent.

Fair weather prevailed. Rain fell on eleven days. The total rainfall for the month was 1.84 inches, which is .98 inch below the Station average for August. The greatest rainfall in 24 hours was .92 inch on the 23d and 24th.

A thunder storm occurred on the 11th.

A fog occurred on the 25th.

The prevailing wind was north-east.

SEPTEMBER.

The mean temperature was 66°, 2° above the Station average for September. The highest temperature, 93°, occurred on the 20th and 21st; the lowest, 38°, on the 9th.

The mean relative humidity was 76 per cent.

Clear weather prevailed Rain fell on six days. The total rainfall for the month was 1.16 inches, 2.24 below the Station average for September. The greatest rainfall in 24 hours was .50 inch on the 4th and 5th.

Thunder storms occurred on the 15th and 19th.

A fog occurred on the 18th.

The prevailing wind was south.

OCTOBER.

The mean temperature was 50°, which is the Station average for October. The highest temperature, 86°, occurred on the 2d and 3d; the lowest, 21°, on the 28th.

The mean relative humidity was 75 per cent.

Clear weather prevailed. Rain fell on eight days. The total rainfall for the month was 2.80 inches, .25 inch above the Station average for October. The greatest rainfall in 24 hours was 1.84 inches on the 18th and 19th.

Killing frosts occurred on the 12th, 13th, 16th, 23d, 28th and 29th; light frosts on the 10th, 11th, 15th, 21st, 24th and 25th.

The prevailing wind was south.

NOVEMBER.

The mean temperature was 40°, which is the Station average for November. The highest temperature, 70°, occurred on the 9th; the lowest, 12°, on the 30th.

The mean relative humidity was 78 per cent.

Cloudy weather prevailed. Rain fell on twelve days, and snow on four. On three of the latter, however, only traces of snow fell. The total snow fall was 2.00 inches; the total rainfall, 5.74 inches, which is 2.58 inches above the Station average for November. The greatest rainfall in 24 hours was 1.96 inches on the 22d and 23d.

Thunder was heard in connection with rain on the 8th and 23d.

Numerous killing frosts occurred.

A fog occurred on the 6th.

The prevailing wind was south.

DECEMBER.

The mean temperature was 39°, 7° above the Station average for December. The highest temperature, 61°, occurred on the 15th; the lowest, 15° on the 19th.

The mean relative humidity was 75 per cent.

Clear weather prevailed, the sky being not more than three-tenths obscured on fifteen days. Rain fell on ten days. Enough snow to measure fell on one day only, traces on three other days. The total snowfall was only .20 inch; the total rain and melted snow 2.42 inches, which is .29 inch. below the Station average for December. The greatest rainfall in 24 hours was .61 inch on the 23d and 24th.

A fog occurred on the 12th.

Numerous white frosts occurred.

The prevailing wind was south.

W. H. BAKER,
Meteorologist.